# THE BAYONNE WATER PIPE CROSSING UNDER THE HACKENSACK RIVER[1]

By Francis H. Sherrerd[2]

To allow for the expansion of The Federal Shipbuilding Company and also for the delivery of an adequate water supply to the City of Bayonne, N. J., through a substantially built system, a contract to lay two lines of 30-inch land pipe about 3300 feet long and two lines of 30-inch flexible joint subaqueous pipe about 1800 feet long, was entered into to replace unsafe lines which had been in service running through the Federal Shipbuilding Company's property and crossing the Hackensack River with two 18-inch flexible joint lines. Some of the work is in Kearney and some in Jersey City and parallels the Lincoln Highway.

The submarine work was particularly interesting and finished in good time by The Snare & Triest Company, contractors, under the direction of M. R. Sherrerd, Consulting Engineer. Class D pipe with a modified Ward or Metropolitan type joint was used, figure 1. The spigot end of the pipe is ball-shaped, machined to a true surface and limited to within $\frac{1}{32}$ inch of the prescribed diameter with a slight rise to the barrel of the pipe at the inner end to act as a bumper in case of an accidental deflecting of the pipe to a greater angle than the 10 degrees allowed in the specifications.

The bell end is a socket with a ring machined to the same shape as the ball 6 inches in from the face of the bell and about $\frac{3}{4}$ inch wide, straight on the inner side and sloping on the outer. Two grooves were cast in for the lead. A steel tire was shrunk on the bell end to give greater strength. It was thought best to use this type of joint as, after calking, the lead remains in the socket end and the ball moves in it and requires less care in lining up the pipe before making each joint and also makes it much easier to calk up all leaky joints.

[1]Read before the New York Section, October 22, 1919. Discussion of this paper is invited and should be sent to the Editor.

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The average amount of lead used per joint was 155 pounds, and the depth of joint about $5\frac{1}{2}$ inches, as one strand of yarn was used.

Great care was used in handling the pipe to prevent scarring the balls. The machined surfaces were carefully scraped and cleaned

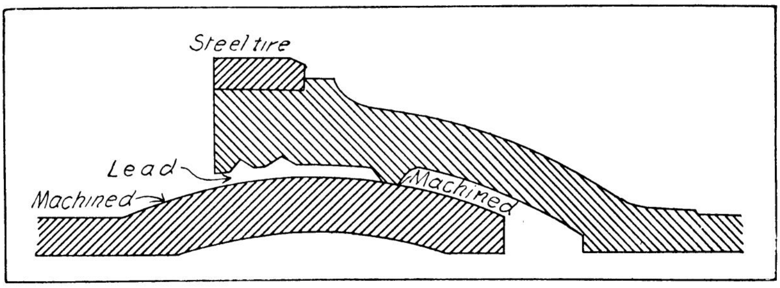


Fig. 1. Flexible Joint on Pipe Across the Hackensack River

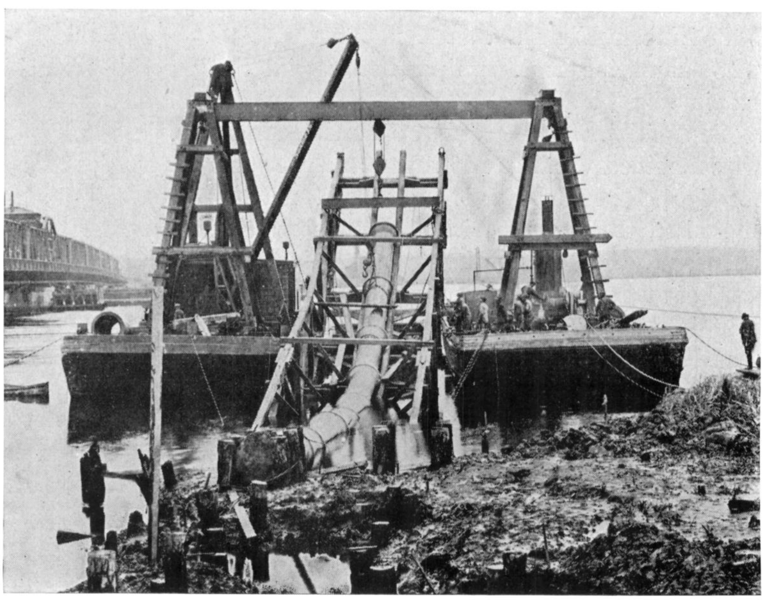

Fig. 2. The Beginning of the Subaqueous Pipe Laying

and oiled before laying. Any sandholes or defects which passed the inspection at the foundry were repaired by boring small holes, larger at the bottom than top, and filling with babbitt metal.

The floating equipment consisted of two large derrick scows carrying an air compressor and pumps, one deck scow, one large launch and a large cradle from which the pipe was laid, figure 2.

The cradle was built of timber, firmly braced and bolted, with a curved track to carry the pipe. The track rested on eight 12-foot members, chords of an arc of a circle of 86 feet radius, each segment being 8 degrees. The long chord at the top of the cradle was about 91 feet. The width of the cradle over all was 16 feet, and that of the tracks about 2 feet 6 inches.

The cradle was swung between one derrick scow and the deck scow in such a manner as to allow easy raising and lowering to prevent too great deflection of the pipe at the bottom of the cradle, caused by the motion of the tide, and also to remain within the limit of deflection on the slopes on each side of the river.

The plans required the laying of the two lines on 20-foot centers and a trench 40 feet wide on the bottom was dredged at a depth of 32 feet below mean low water between pierhead lines. From the pierhead line to the shore on one side of the river an easy slope of approximately 10 to 1 was possible, but on the other it was necessary to make it about 4 to 1. As this was at the far end of the work, it was quite difficult to carry the cradle at the right angle to keep the foot of it so that the slope would be tangent to it. All mud was removed and replaced with sand and clay and the uneven bottom smoothed out within reasonable limits. About 100,000 yards of material was dredged.

One derrick scow was used to load pipe at the dock and to assist in the handling of the cradle. The two other scows firmly lashed and carrying the cradle were anchored in such a way as to carry the center of the cradle in line with rangers set on the shore.

One length of pipe at the start was made fast in an anchorage of piles on the shore. Next two sets of two lengths each were made up on the deck of a scow and lowered in line. Then the joints were poured and calked and the whole laid on the lower end of the cradle, the upper end of the cradle having been hoisted high in the air. After that each length was laid separately in the cradle and lashed securely so that the whole might not slide. The bell end of the last length laid was blocked off the curved track so that the spigot end of the one to be laid could be lowered in, leaving the two in nearly a straight line. Care was taken to see that the last joint made was not deflected too much. The joint was then made and calked

hard, the block taken out and joint broken by lowering it into the curved track again. The lashing on the pipe was then loosened and scows and cradle moved back in line by tightening and loosening anchor lines.

In going up the slope on the far side of the river, more trouble from leaky joints was expected owing to the natural pushing of the ball into the socket and possible pushing away from the lead, but by careful calking this was overcome and only three or four leaks of any consequence resulted, although as a result of the hard calking it was much more difficult to break the joints.

On the first line the use of the cradle was stopped at about six lengths from shore and it was pulled out with an end and side motion, moving the pipe, without intention, to the limit of deflection in two joints, which, in combination with the action of the tide when the pipe was suspended from a derrick, caused them to leak and made it necessary to calk them again. The last three lengths laid were then suspended from one derrick scow and the remaining lengths laid from the other.

At the end of the laying of the second line, the cradle was unbolted in the middle and taken out in two pieces so that the pipe was not disturbed.

Each day's work was inspected from the inside and any dripping joints or bad bends were noted.

This was done by lowering a man down the pipe from the cradle end and although it required great physical effort proved much more satisfactory than diver's inspection. From the shore ends the pipe on the slope was easily inspected down to the place where water leaking through the bulkheads would make it inconvenient. The shore ends of the pipes were below high water and often the bulkheads were not perfectly water-tight.

It was found easily possible to repair leaks from the inside, but where more than two or three appeared it was cheaper to repair by calking by divers on the outside. It took considerably more than 100 pounds of lead wool to repair a small leak on the inside and on account of cramped quarters and the curved shape of joint took too long a time.

The first line was laid at the rate of 6.8 lengths per day and the second at 7.9. The best day's work was 18 lengths, and a rate of 12 lengths per day could easily have been maintained after organization had it not been for delay in dredging and bad weather.

The force required for laying consisted of three calkers, three riggers, three engineers, four laborers.

The specifications required both air and water tests. Nearly all leaks showed at 10 pounds air pressure. The pressure was finally raised to 70 pounds, but all leaks that showed at 70 also showed at 40.

On the first line, after repairing all visible leaks, the pressure was raised to 72 pounds at 4 p.m. At 8 the next morning it was 61 pounds. On the second line at 3 p.m. the pressure was raised to 70 pounds and at 8 the next morning was 55 pounds, in spite of an air leak in one of the valves.

The water leakage allowed amounted to about 1 cubic foot a minute for 24 hours. The lines were filled with fresh water, although the specifications allowed sea water, and all was sterilized by the addition of hypochlorite in the proportion of two parts available chlorine per 1,000,000. The leakage was so small that the pumps could not be run slowly enough not to exceed the required pressure. In the first line the pressure was raised to 108 pounds at 3.30 p.m. At 5.30 it was still 108 and at 8 the next morning was 91½ pounds. It took 50 cubic feet of water pumped in 11 minutes to bring it back to 108 pounds. On the second line the pressure was raised to 100 pounds and after 1 hour fell to 98 pounds. It took 7 cubic feet of water pumped in 6 minutes to bring it back to 100 pounds. After 20 minutes there was no perceptible loss in pressure.

The pipe is now being covered with a sand blanket 3 feet deep by means of a derrick scow equipped with a hopper and pipe which can be adjusted with a telescope arrangement to fill almost exactly to the required depth. This and the construction of two large concrete blocks over the anchor piles on the shore end will complete the job.